

1. An excavator tooth useful for fracturing rock strata, comprising:
  - A. a metallic core having front and rear ends and at least one longitudinal surface extending between said ends;
  - B. at least one projection formed from metallic stock and having a tip; said projection being secured to the core at least in part by welding with the tip and at least a portion of the length of the projection(s) extending beyond the front end of the core; and
  - C. in or on the core, at least one tooth connector portion, including at least one concave or convex connector surface, of circular or other configuration, positioned and adapted to engage with and non-destructively disengage from at least one mating surface of an excavator apparatus.
2. An excavator tooth according to claim 1 wherein the core is of circular cross-section and has a single longitudinal surface in the form of a cylinder.
3. An excavator tooth according to claim 1 wherein the core is of non-circular cross-section and has plural longitudinal surfaces.

- 1 4. An excavator tooth according to claim 1 wherein the at least one  
2 projection preferably includes at least one cut edge.
- 3 5. An excavator tooth according to claim 1 wherein the projection  
4 metallic stock thickness is about 1/2 to about 3, or about 3/4 to about  
5 2 and 1/4 or about 1 to about 1 and 1/2, inches.
- 6 6. An excavator tooth according to claim 1 wherein the tooth includes at  
7 least one projection which has on opposite sides thereof, as viewed  
8 in transverse cross-section, at least two approximately planar  
9 surfaces which are approximately parallel to one another.
- 10 7. An excavator tooth according to claim 1 having at least two of said  
11 projections thereon.
- 12 8. An excavator tooth according to claim 4 wherein two projections are  
13 secured to substantially opposite sides of the core.
- 14 9. An excavator tooth according to claim 4 wherein at least two of said  
15 projections have inner major surfaces, portions of which surfaces  
16 generally face one another and extend forwardly from the core, said  
17 portions, as they progress toward their tips, having an angle of  
18 divergence between them of about 0 to about 30 degrees, preferably  
19 about 2 to about 30 degrees, more preferably about 12 to about 24

degrees, still more preferably about 16 to about 20 degrees and most preferably about 18 degrees.

10. An excavator tooth according to claim 1 wherein the metallic stock is of abrasion resistant steel having a surface BHN (Brinell Hardness Number) of at least about 225, preferably at least about 300, more preferably at least about 350, more preferably at least about 375 and still more preferably at least about 400.

11. An excavator tooth according to claim 7 which comprises iron, carbon, manganese and silicon, and optionally but preferably at least one additional alloying element selected from the group consisting of chromium, nickel, boron, molybdenum, vanadium, titanium, copper, aluminum, niobium and nitrogen.

12. An excavator tooth according to claim 8 wherein the sulfur and phosphorous contents of the plate are respectively less than about 0.05, preferably less than about 0.04 and still more preferably less than about 0.030 percent by weight of the entire plate stock.

13. An excavator tooth according to claim 1 wherein there is a narrowing of at least one projection, between its generally longitudinal edges, in the direction of the tip.

- 1 14. An excavator tooth according to claim 1 wherein first and second  
2 longitudinal edges of at least one projection, or more preferably first  
3 and second edges of a plurality of projections, converge with one  
4 another, along at least a portion of their respective lengths, in the  
5 direction of their tip or tips.
- 6 15. An excavator tooth according to claim 14 wherein such narrowing, or  
7 such convergence, exists at least closely adjacent to the tip or tips.
- 8 16. An excavator tooth according to claim 14 wherein the projection  
9 edges converge, as the edges approach the tips, preferably at an  
10 angle of about 10 to about 35 degrees, more preferably about 15 to  
11 about 30 degrees, still more preferably about 17 to about 25 degrees  
12 and even more preferably about  $21 \pm 2$  degrees.
- 13 17. An excavator tooth according to claim 14 comprising convergence of  
14 at least portions of projection longitudinal edges along substantially  
15 straight lines, preferably closely adjacent to their tip or tips.
- 16 18. An excavator tooth according to claim 14 wherein convergence  
17 occurs over at least about 25% and more preferably up to at least  
18 about 100% of the length of the projection longitudinal edges
- 19 19. An excavator tooth according to claim 14 wherein the angles of  
20 convergence between edges as the edges approach the tips is

generally about 10 to about 35 degrees, preferably about 15 to about 30 degrees, more preferably about 17 to about 25 degrees and still more preferably about  $21 \pm 2$  degrees.

20. An excavator tooth according to claim 1 or 19 including a projection with two convergent edges that are cut edges.

21. An excavator tooth according to claim 1 wherein at least one projection is secured to the core through at least one longitudinal surface of the core.

22. An excavator tooth according to claim 1, 7 or 21 wherein the projection or projections is/are secured to the core entirely by welds.

23. An excavator tooth according to claim 1 comprising a plurality of said projections that respectively extend along at least a portion of a given longitudinal surface and are secured to the core at least in part by welds between the given surface and adjacent portions of the projections.

24. An excavator tooth according to claim 1 wherein the tooth connector portion is located at the rear end of the core.

25. An excavator tooth according to claim 1 wherein the tooth connector portion is located in or on a rearmost surface of the core.

- 1     26.    An excavator tooth according to claim 1 wherein the tooth connector  
2           portion is securely connected with a mating surface of an excavator  
3           apparatus.
- 4     27.    An excavator tooth according to claim 26 wherein the tooth connector  
5           portion is a female member extending into the rear end of the core  
6           and the mating surface is a male member on an excavator  
7           apparatus.
- 8     28.    An excavator tooth according to claim 26 wherein the tooth connector  
9           portion is a male member extending rearwardly from the rear end of  
10          the core and the mating surface is a female member on an excavator  
11          apparatus.
- 12    29.    An excavator tooth according to claim 26 wherein a locking member  
13          engaging the tooth and a portion of the excavator apparatus provides  
14          security for the connection between the tooth connector portion and  
15          the mating surface.
- 16    30.    An excavator tooth according to claim 29 wherein the locking  
17          member is a resilient insert or metallic pin.

- 1 31. An excavator tooth according to claim 26 wherein the excavator  
2 apparatus is an excavating machine adapted to carry, in working  
3 position, one or more teeth constructed according to the invention.
- 4 32. An excavator tooth according to claim 26 wherein the excavator  
5 apparatus is an excavating machine selected from the group  
6 consisting of power shovels, backhoes, draglines, dredges, graders  
7 and bulldozers.
- 8 33. An excavator tooth according to claim 26 wherein the excavator  
9 apparatus is a digging attachment or combination of attachments  
10 adapted to be mounted on an excavating machine and to carry, in  
11 working position, one or more of said teeth.
- 12 34. An excavator tooth according to claim 1 connected with a bucket  
13 having a mounting pin for connecting the bucket to an excavating  
14 machine, the tooth having a projection with a major surface which is  
15 held in approximately perpendicular relationship with the longitudinal  
16 axis of the mounting pin.
- 17 35. An excavator tooth according to claim 1 connected with a rock  
18 ripping tool having a mounting pin for connecting the tool to an  
19 excavating machine, the tooth having a projection with a major  
20 surface which is held in approximately perpendicular relationship with  
21 the longitudinal axis of the mounting pin.

- 1 36. An excavator tooth according to claim 1 connected with a bucket or  
2 blade at a substantially rectilinear cutting edge of the bucket or blade,  
3 said edge defining a digging axis, a major surface of the tooth being  
4 held in approximately perpendicular relationship with that axis.
- 5 37. An excavator tooth according to claim 1 connected with a bucket or  
6 blade having an at least partly non-rectilinear cutting edge having  
7 ends at sides of the bucket or blade, said bucket or blade having a  
8 digging axis defined by an imaginary line connecting said ends, a  
9 major surface of the tooth being held in approximately perpendicular  
10 relationship with that axis.
- 11 38. An excavator tooth according to claim 1 connected with a digging  
12 end of a pivotable ripping arm for an excavating machine, said arm  
13 having a pivoting axis about which the arm swings in operation, a  
14 major surface of the tooth being held in approximately perpendicular  
15 relationship with the axis.  
16
- 17 39. A method of excavation with an excavating machine having an arm  
18 with a pivot affording angular movement of an end of the arm about a  
19 central axis of the pivot, said arm supporting and delivering digging  
20 force and motion to a digging implement having projections, said  
21 method comprising applying such force through projections that are



1 formed of cut plate stock and have major surfaces that are  
2 approximately perpendicular to said axis.

3 40. A method of fracturing rock or frozen earth with an excavating  
4 machine having an arm with a pivot affording angular movement of  
5 an end of the arm about a central axis of the pivot, said arm  
6 supporting and delivering digging force and motion to a digging  
7 implement able to apply sufficient force through the tips of projections  
8 on said implement to break up the strata, said method comprising  
9 applying such force through projections that are formed of cut plate  
10 stock and have major surfaces that are approximately perpendicular  
11 to said axis.

12 41. A method according to claim 39 or 40 comprising applying such force  
13 through one or more teeth having edges that converge at angles of  
14 convergence between edges as the edges approach the tips of  
15 generally about 10 to about 35 degrees, preferably about 15 to about  
16 30 degrees, more preferably about 17 to about 25 degrees and still  
17 more preferably about  $21 \pm 2$  degrees.

18 42. A method according to claim 39 or 40 comprising applying such force  
19 through one or more teeth respectively having at least two of said  
20 projections with tips and inner major surfaces, portions of which  
21 surfaces generally face one another and extend forwardly from the  
22 core, said portions, as they progress toward their tips, having an

angle of divergence between them of about 0 to about 30 degrees,  
about 2 to about 30 degrees, or about 12 to about 24 degrees, or  
about 16 to about 20 degrees or about 18 degrees.

43. A method according to claim 39 or 40 comprising applying such force  
through teeth wherein the plate stock is abrasion resistant steel plate  
having a surface BHN (Brinell Hardness Number) of at least about  
225, more preferably at least about 300, more preferably at least  
about 350, more preferably at least about 375 and more preferably at  
least about 400.

44. A method according to claim 39 or 40 comprising applying such force  
through teeth which comprise iron, carbon, manganese and silicon,  
and optionally but preferably at least one additional alloying element  
selected from the group consisting of chromium, nickel, boron,  
molybdenum, vanadium, titanium, copper, aluminum, niobium and  
nitrogen.